In Situ Perchlorate Bioremediation for Soil and Groundwater

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Presentation Overview

- Overview of In Situ Treatment
- Groundwater In Situ Treatment
- Soil In Situ Treatment
- Summary

In Situ Groundwater Treatment Technologies

- Chemical Treatment
  - Oxidation
  - Reduction
- Biological Treatment
  - Aerobic
  - Anaerobic

Key to Successful In Situ Biotreatment

Adjust in situ conditions to provide the microbes degrading the contaminant with the required environment.

Perchlorate Biodegradation Amendments

- Microbial Augmentation
- Electron Donor (Carbon Source)
- Anaerobic Conditions
- Nutrients
- pH Buffer

Amendment Delivery Considerations: Groundwater

- Aquifer Characteristics
- Contamination Characteristics
- Electron Donor Characteristics

Aquifer Considerations

- Shallow vs. Deep
- High vs. Low Conductivity
- Groundwater Gradient
- Seasonal Groundwater Flow Patterns
- Confining Unit
- Geochemical Characteristics

Contamination Characteristics

- Contaminant Concentration
  - Source Area
  - Downgradient Plume
- Plume Shape and Location
- Downgradient Receptors
- Co-contaminants

Electron Donor Characteristics

- Solid vs. Liquid Phase
- Material Cost
- Application Cost
- Longevity

Amendment Delivery Methods

- Permeable Reactive Barriers (PRB)
- Extraction/Infiltration Wells (or Trenches)
- Temporary Injection Points (DPT)

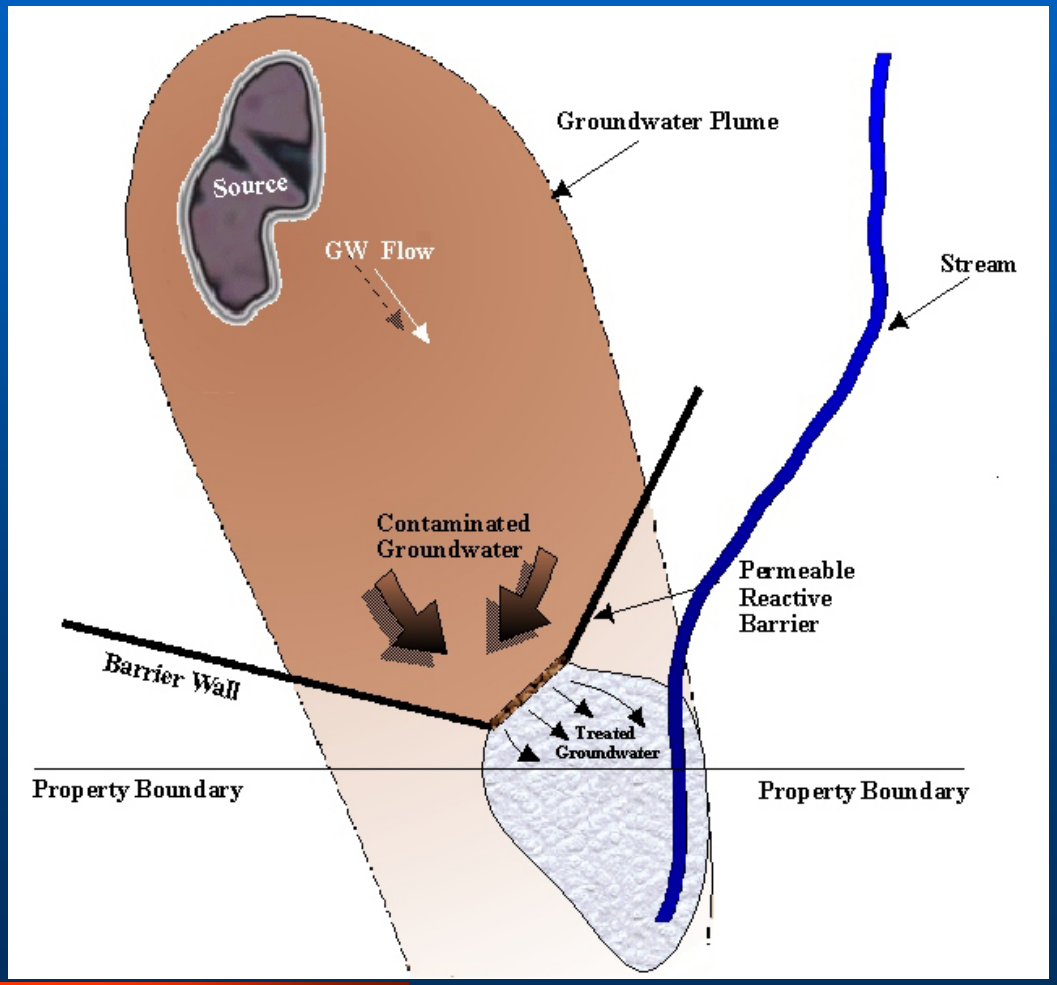
Permeable Reactive Barrier

- Reactive Materials in Subsurface
- Intercept the Contaminant Plume
- Flow Path through Reactive Media
- Contaminant Degradation within the Barrier

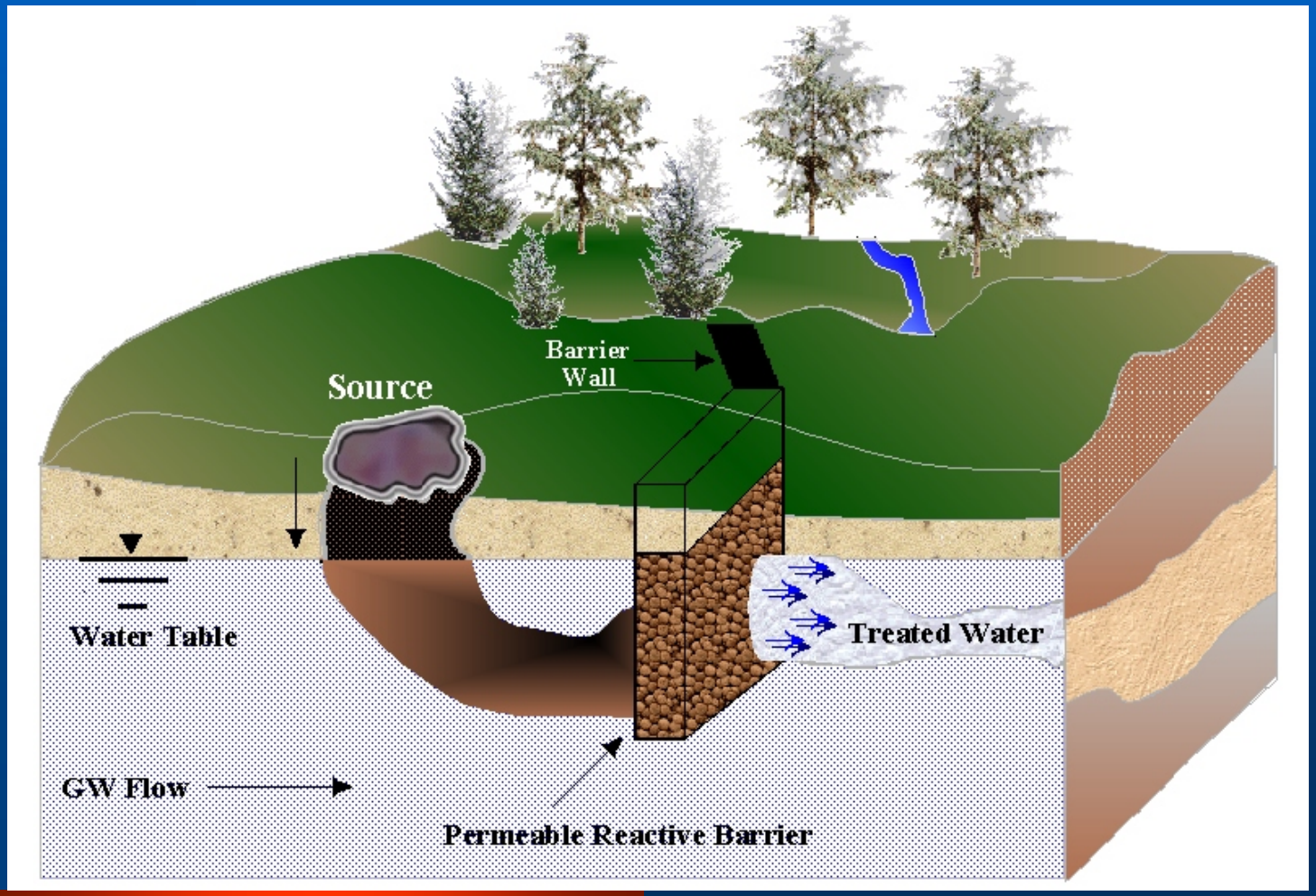
Permeable Reactive Barriers

- Associated with Chemical Treatment
  - Zero-Valent Iron
- Passive
- Typical Configurations
  - Funnel-and-Gate
  - Continuous Trench

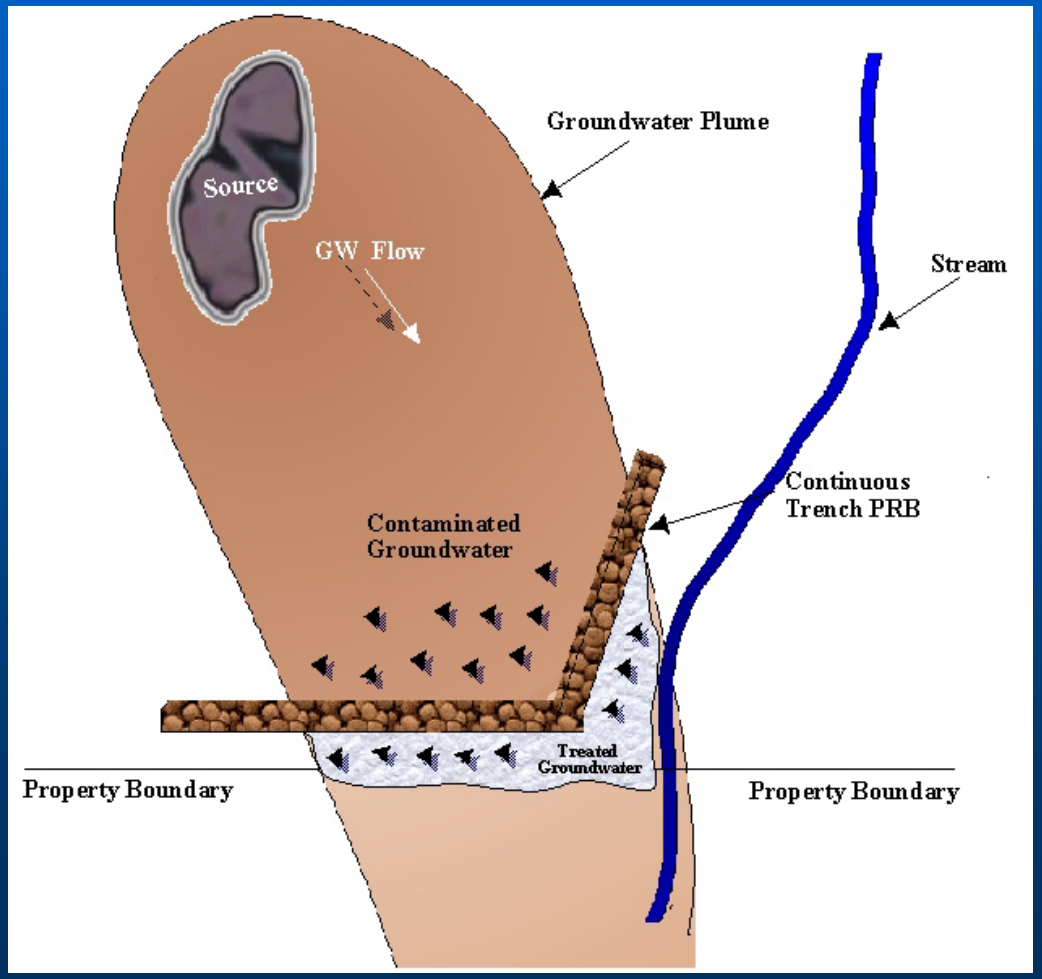
Funnel-and-Gate PRB Plan



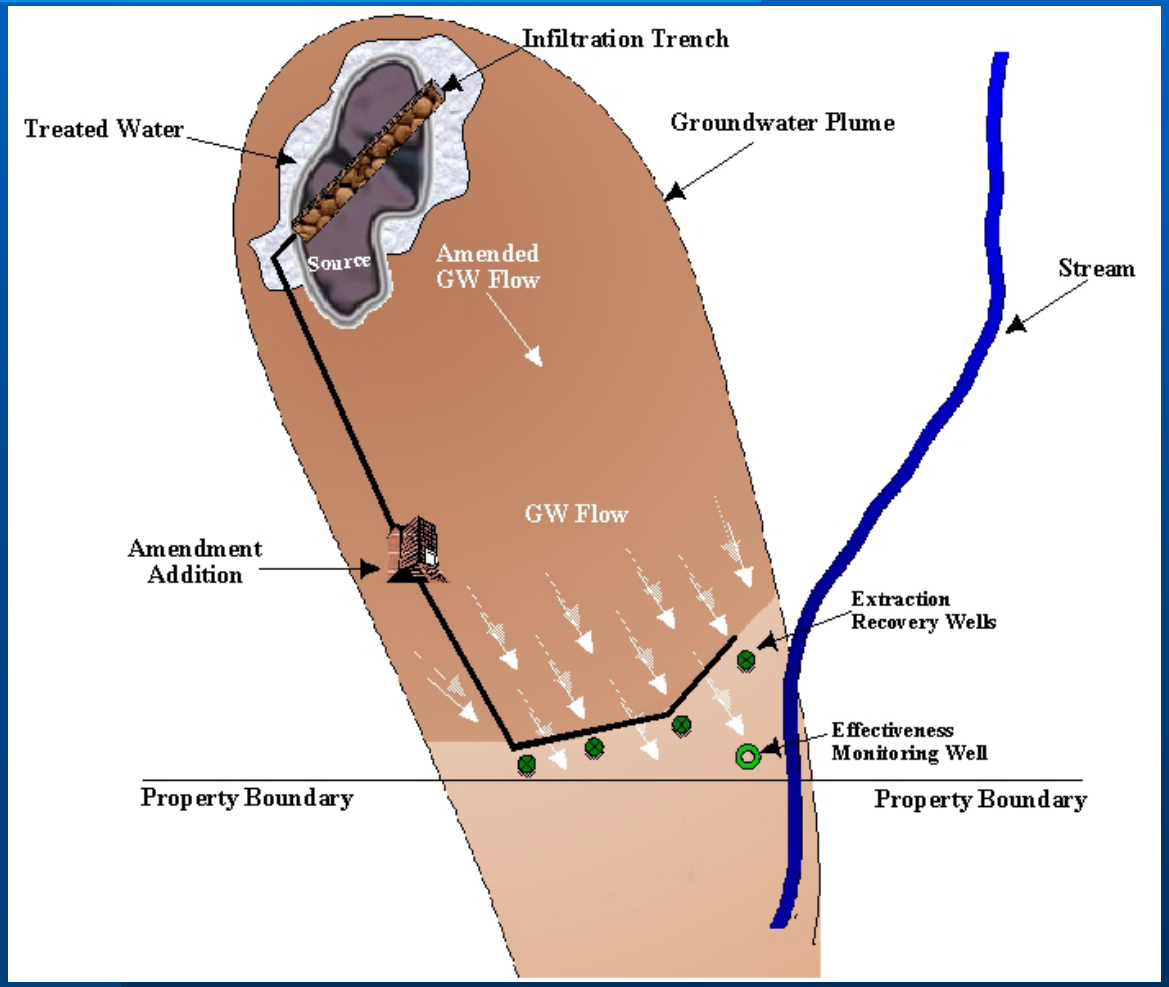
Funnel-and-Gate PRB Profile



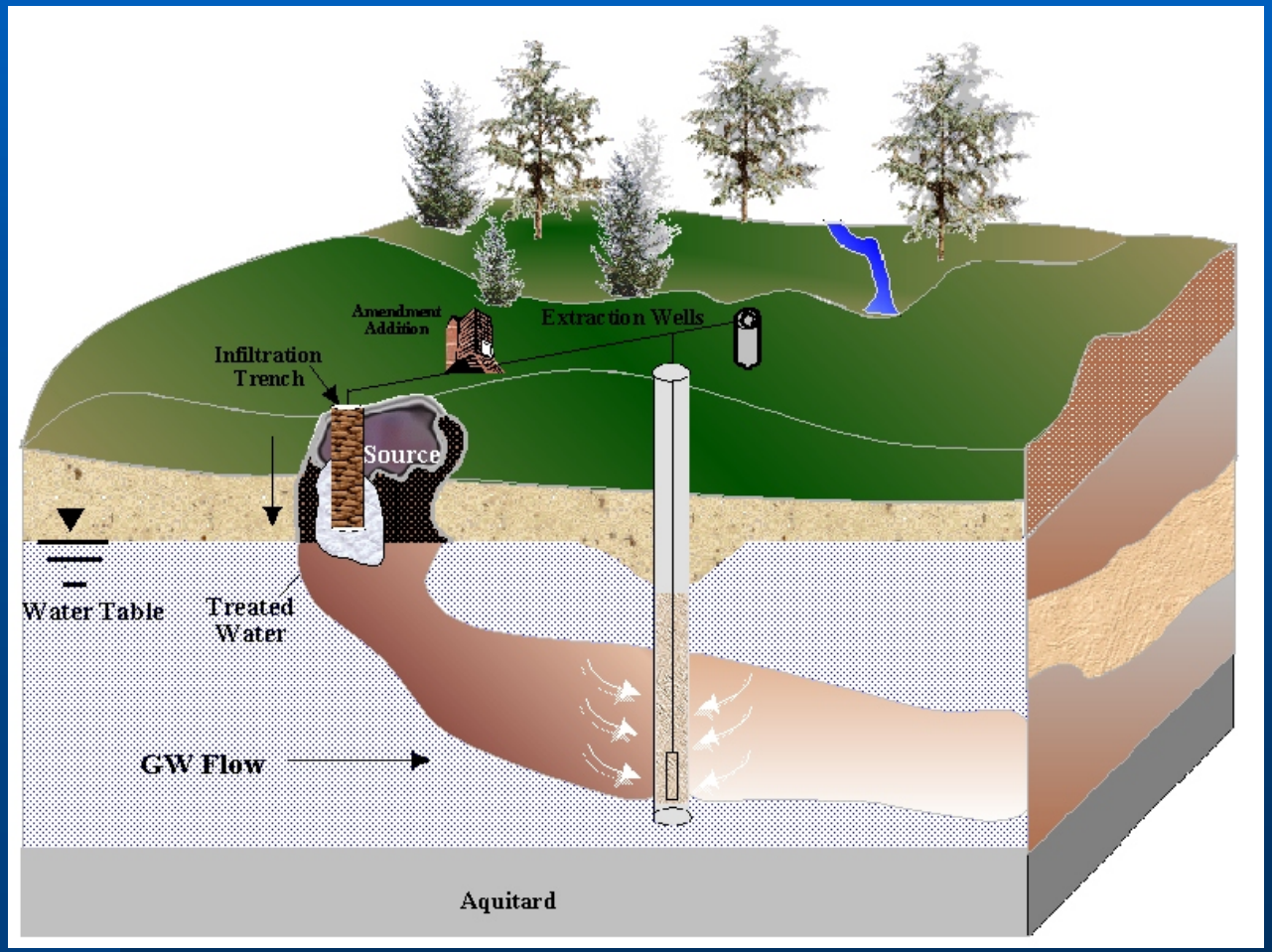
Continuous Trench PRB Plan



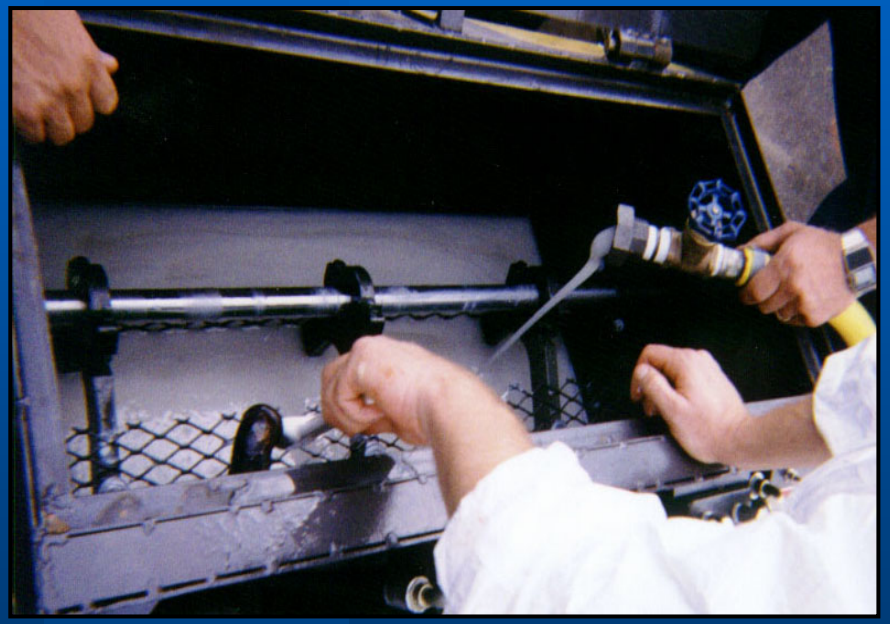
Extraction/Infiltration Plan



Extraction/Infiltration Profile



Temporary Injection Points Direct-Push Technology

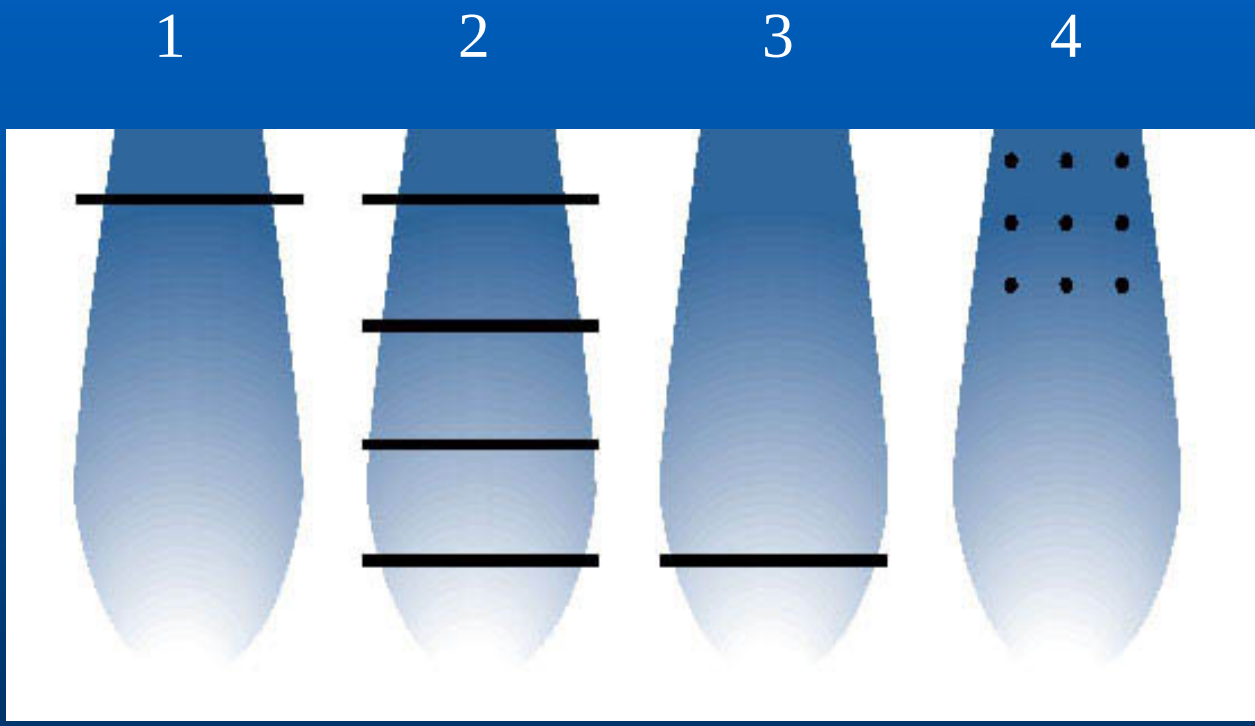


HRC is a viscous but injectable substance

HRC injected using DPT

HRC Barrier Designs

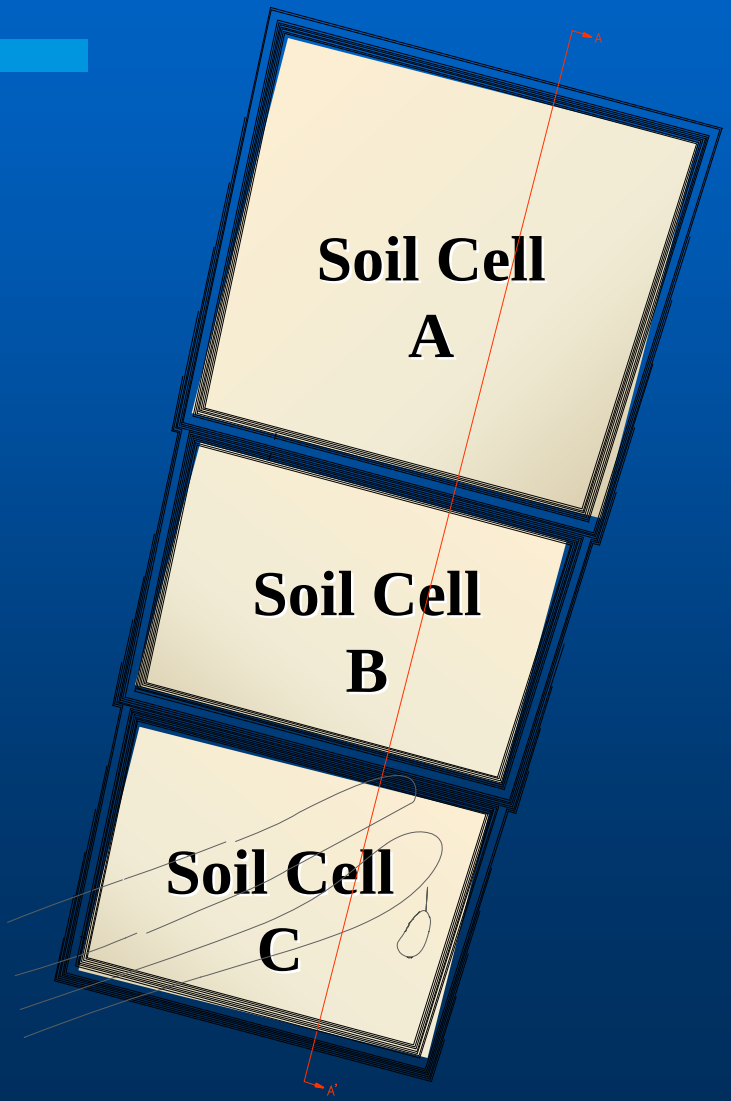
1. Upgradient Barrier
2. Series of Barriers
3. Downgradient Barrier
4. “Grid” of HRC injection points



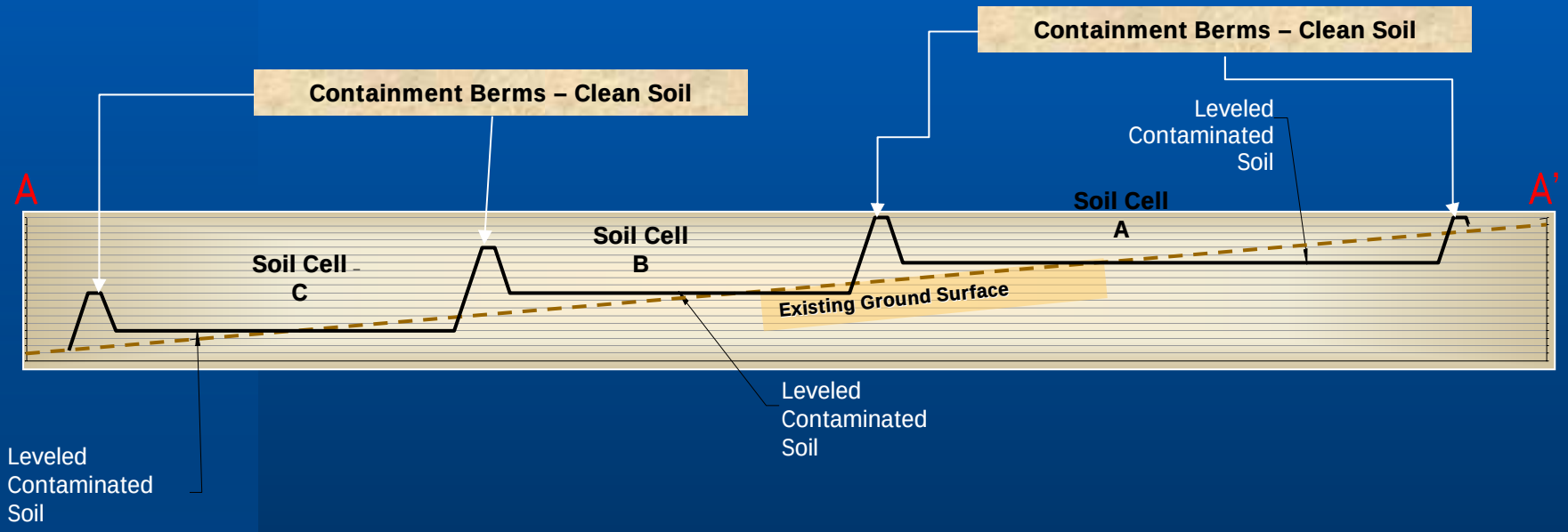
In Situ Soil Treatment Anaerobic Landfarming

- Anaerobic Conditions
- Bioaugmentation
- Amendments
- Moisture

Soil Treatment Cell Plan



Soil Treatment Cell Profile



Factors Favoring In Situ Perchlorate Biodegradation

- Abundance of Perchlorate-Respiring Microorganisms (PRM)
- Not Toxic at High Concentrations
- Rapid Biodegradation Rates
- Degradation to Below Detection Limits
- No Toxic Degradation Products
- Inexpensive Electron Donors